SSA Positive Peanut detections in dehydrated Chinese Garlic

Background

The issue of positive peanut detections in size reduced, predominantly powdered, dehydrated garlic from China first came to light in 2015 following the introduction of increased surveillance testing. Agricultural and postharvest practices were determined to be the root cause. Over the past decade there has been extensive ongoing reviews of controls at source by member companies of The Seasoning and Spice Association (SSA). Heightened controls have included enhanced segregation and management practices at agricultural, postharvest, washing, drying, storage and processing stages, alongside strengthened allergen management in factories. Despite the improvements, and with the refinement in commercial testing capabilities, positive peanut protein detection still occur at high frequency. Tolerance limits for release onto market are governed by the non-regulated industry specification limit informally adopted in 2015 of 2.5mg/kg. Typically, detected levels are not consistently observed across all samples from the same batch or consignment.

Introduction:

In April 2025, the SSA formed a Task Force to champion the investigatory work into the positive peanut protein detections in dehydrated garlic sourced from China.

This paper aims to address the underlying causes of the significant challenge that positive peanut protein detections can cause; it does not aim to define a single root cause. It will recommend future focus on the topic of positive peanut protein detection in dehydrated garlic that will require a collaborative approach from subject matter experts. The paper and findings are intended for the food ingredients industry, regulators and enforcement authorities in the UK and across the globe to aid interpretation of analytical results and subsequent critical decision making.

In 2015, due to the detections in dehydrated Chinese garlic, the industry immediately reacted requesting the inclusion of the mentioned analyte in raw material specifications from Chinese suppliers for dehydrated garlic aligning widely to <2.5 mg/kg, reflecting the limits of quantification of commercially available analytical methods at the time. At the time there was no differentiation of peanut protein or whole peanut.

It is widely recognised that although the testing methodology available to industry is the best currently available, there are analytical and methodological challenges. There is a lack of equivalence and reproducibility between different ELISA test kits from different manufacturers and occasionally between different kits for the same allergen from the same manufacturer. Food processing can impact on how a test performs as they may alter the target protein structure making them harder to extract or detect. Many of the methods, in particular antibody-based ones such as ELISA can show cross reactivity which may lead to false positives particularly if the specific matrix hasn't been validated. Unlike many other types of analytical testing there is a lack of harmonised standards and certified reference materials making it difficult to consistently calibrate methods and compare data sets between laboratories.

A clear understanding of what an analytical result represents is essential before decisions are made, including target measured, units reported and any assumptions applied during interpretation e.g conversion factors. Checks should be made that the laboratory should be validated for the matrix that they are testing.

When considering reference doses derived from eliciting dose distributions (e.g., ED01 and ED05) the recent history suggests that a <2.5mg/kg peanut limit in dehydrated garlic is protective of health to an acceptable level, especially when applying the dilution factor calculations in food recipes. At levels of 2.5mg/kg peanut protein, a peanut allergy sufferer would need to consume at least 80g (ED01) or 800g (ED05) of dehydrated garlic in one serving to invoke a reaction.

Any consideration of dilution or recipe factors should be undertaken at the finished-product level and based on clearly defined use scenarios rather than applied generically at raw-material intake using tools such as the SSA Allergen Risk Assessment Model.

The levels of detected peanut protein in dehydrated garlic that the SSA (and global industry) are finding fall within ED05 thresholds. Nevertheless, the SSA does not endorse supply of unsafe food.

Literature review:

A targeted review of available literature was conducted to identify studies relevant to peanut and garlic processing, heat treatment, and allergen testing. Searches were performed using combinations of key terms including but not limited to “peanut”, “garlic”, “heat treatment”, and “allergen testing” across academic search platforms, including Google Scholar and Google.

Market Action Alerts

Alerts relating to the presence of peanut in garlic were identified using the subscription service Fera Horizon Scan. Between 2015 and 2025, a total of 17 alerts were recorded. Of these, 13 were raised in 2025, with single alerts reported in 2024, 2022, 2016 and 2015.

Where available, reported levels of peanut were collated. The alert issued in 2015, when this issue was first emerging, reported a level of 610 mg/kg; however, analytical methods at that time did not report peanut protein, limiting direct comparability with more recent data. In 2025, three alerts included quantitative results, with reported values ranging from 0.3 to 0.62 mg/kg. No quantitative information was available for alerts issued in 2016, 2022 or 2024. None of the measurements were defined as whole peanut or peanut protein.

Peanuts contain about 22–30% crude protein, making them a rich plant-based protein source.
Not all peanut proteins are equally detectable by available methods, and processing could affect protein structure, extractability and detectability.

The proteins in peanut are mainly divided into albumins and globulins. The proteins within peanut perform many different functions and of those present up to 18 have been officially recognised as peanut allergen proteins, with Ara h 1,Ara h 2, Ara h 3, and Ara h 6 being identified as the key allergenic proteins in peanut.

Processing from end to end dehydrated garlic production

Previous conclusions from other studies and investigations have been considered as part of this review including agricultural and postharvest cross contamination and further processing i.e. dehydration and size reduction. Part of the consideration is the unintentional heat application during processing and the impact on molecular stability.

Experimental design:

The SSA designed a small-scale experiment using prominent commercial laboratories to explore the consistency and reliability of detecting trace peanut contamination in size reduced dehydrated garlic, comparing results across multiple methods, laboratories, and test kits. This approach has allowed the SSA to have full transparency of the data used within this paper. Whilst the number of samples submitted for the experiment may not be considered statistically significant it does provide insight into some of the challenges faced by manufacturers when implementing screening processes.

ISO17025 commercial laboratories across the UK were contacted using the same basic email requesting details on test kits available and pricing for peanut analysis on dehydrated garlic.

The most prevalent testing method offered was ELISA, utilising the R-Biopharm Radascreen kit. Given the lack of variation in kits being proposed by the laboratories, it was decided to send samples to two laboratories using R-Biopharm Radascreen ELISA kit, one laboratory using Sensispec ELISA kit and one laboratory offering a PCR method.

Purpose:
To assess variability in peanut detection in size reduced dehydrated garlic across different samples, laboratories, and test kits.

Sample Collection:

- Some SSA members provided a 2 kg aggregated sample from a single batch code.
- Representative samples were taken using the square root plus one method to ensure batch representation (e.g., for 500 bags, sample 23 bags).
- Each bagged sample was ~100g, combined to form the bulk sample.
- All samples provided by manufacturers had been screened via their own internal processes.

Laboratory Sample Preparation:

- Each SSA member submitted 10 individual lab samples (100g each) from the bulk sample.
- Samples were labelled systematically and anonymized by the SSA secretariat using a four-digit prefix.

Laboratory Testing:

- Four laboratories participated: three using ELISA, one using PCR.
- ELISA laboratory selected was based on test kit, LOD/LOQ, and in-house testing.
- Laboratory selection was confirmed by the Task Force before sample submission.Selection of analytical methodology should consider matrix suitability, method limitations, and the intended use of the data. Results should be interpreted by suitably competent personnel.

Results:

The results from the testing are summarised in Table 1. The information provided from each laboratory regarding the analyte measured and the basis of result expression highlighted differences in reporting approaches.

Table 1. Results from the testing

Sample number	Granulation of sample	Results (mg/kg) ELISA R-Biopharm/ELISA CoA states peanut – ELISA[1] 0.75ppm LOQ/ 0.15ppm LOD		Result (ppm) R-Biopharm Ridascreen CoA states Whole peanut detection 0.75ppm LOQ		Result mg/kg Sensispec CoA states peanut allergen ELISA[2] LOQ / LOD 0.2ppm		Result mg/kg PCR IFP Complete LOD 1ppm
		Result COA	Converted Peanut Protein	Result COA	Converted Peanut Protein	Result COA	Converted Peanut Protein	Result COA
1010-A	Powdered	<0.75		< 0.75		<1		<1
1010-B	Powdered	<0.75		< 0.75		<1		
1010-C	Powdered	<0.75		< 0.75		<1		
3030-A	Powdered	3.9	0.858	3.8	0.836	4.3	0.946	<1
3030-B	Powdered	3.7	0.814	3.4	0.748	**5.6**	**1.232**	
3030-C	Powdered	4.3	0.946	3.2	0.704	4.6	1.012	
5050-A	Powdered	1	0.22	< 0.75		1.1	0.242	<1
5050-B	Powdered	1.1	0.242	<0.75		1.3	0.286	
5050-C	Powdered	1.2	0.264	3	0.66	1.4	0.308	
7070-A	Granulated	0.8	0.176	< 0.75		2.5	0.55	<1
7070-B	Granulated	1	0.22	< 0.75		1	0.22	
7070-C	Granulated	1.1	0.242	< 0.75		<1		

[1] The lab stated the results are expressed as peanut

[2] The lab stated the results are expressed as peanut commodity 1ppm

It was confirmed that all the ELISA results reported were for whole peanut. As per the instructions for the test kits used for the analysis to convert the reported level to peanut protein a conversion factor of 0.22 was applied.

Table 2. Z Scores of Samples from Manufacturer 1

Sample No	Granulation of sample	Results mg/kg	Z Score
3030-1A	Powdered	3.9	-0.277534838
3030-1B	Powdered	3.7	-0.571395255
3030-1C	Powdered	4.3	0.310185996
3030-2A	Powdered	4.3	0.310185996
3030-2B	Powdered	5.6	**2.220278705**
3030-2C	Powdered	4.6	0.750976621
3030-3A	Powdered	3.8	-0.424465046
3030-3B	Powdered	3.4	**-1.01218588**
3030-3C	Powdered	3.2	**-1.306046297**
3030-4D	Powdered	<1	N/A

Table 3. Z Scores of Samples from Manufacturer 2

Sample No	Granulation of sample	Results mg/kg	Z Score
5050-1A	Powdered	1	-0.683675692
5050-1B	Powdered	1.1	-0.52929731
5050-1C	Powdered	1.2	-0.374918928
5050-2A	Powdered	1.1	-0.52929731
5050-2B	Powdered	1.3	-0.220540546
5050-2C	Powdered	1.4	-0.066162164
5050-3A	Powdered	< 0.75	N/A
5050-3B	Powdered	<0.75	N/A
5050-3C	Powdered	3	**2.403891948**
5050-4D	Powdered	<1	N/A

Table 4. Z Scores of Samples from Manufacturer 3

Sample No	Granulation of sample	Results mg/kg	Z Score
7070-1A	Granulated	0.8	-0.77702869
7070-1B	Granulated	1	-0.453266736
7070-1C	Granulated	1.1	-0.291385759
7070-2A	Granulated	2.5	1.97494792
7070-2B	Granulated	1	-0.453266736
7070-2C	Granulated	<1	N/A
7070-3A	Granulated	< 0.75	N/A
7070-3B	Granulated	< 0.75	N/A
7070-3C	Granulated	< 0.75	N/A
7070-4D	Granulated	<1	N/A

Table 5. Z Scores for Samples from Manufacturer 4

Sample No	Granulation of sample	Results mg/kg	Z Score
1010-1A	Powdered	<0.75	N/A
1010-1B	Powdered	<0.75	N/A
1010-1C	Powdered	<0.75	N/A
1010-2A	Powdered	<1	N/A
1010-2B	Powdered	<1	N/A
1010-2C	Powdered	<1	N/A
1010-3A	Powdered	< 0.75	N/A
1010-3B	Powdered	< 0.75	N/A
1010-3C	Powdered	< 0.75	N/A
1010-4D	Powdered	<1	N/A

Discussion:

To compare the repeatability of the results, Z scores were calculated across each of the sample group i.e. 1010 / 3030 etc to understand the variability in levels reported across the different laboratories. Except for sample 1010 where all results were <LOQ, the Z scores indicated a level of variability which some data

points would be considered an unusual deviation from the mean or an outlier <2 however these would still be considered satisfactory and not significant

The ED01 value for peanut protein (the eliciting dose predicted to provoke objective allergic reactions in 1% of peanut-allergic individuals) recommended by the FAO/WHO Codex review is 0.2 mg of peanut protein, the ED05 value is 2.0mg of peanut protein, a ten-fold increase.

When using these values, it was calculated at the highest concentration of peanut protein reported, 1.232mg/kg, over 162.3g of garlic powder would need to be consumed in a single eating occasion to exceed ED01 and over 1623g to exceed ED05.

The current SSA Allergen Risk Assessment Model for dried herbs and spices lists that a teaspoon of garlic powder / granules weighs 4g. A typical recipe containing garlic powder to produce 4 servings is 1 teaspoon meaning a single serving amount of 1g, demonstrating that the levels likely to be consumed fall well below those calculated to exceed the ED01 & ED05 values.

Consumption estimates represent common use scenarios and should be reviewed by individual businesses against specific formulations and consumer use patterns.

The role of quantitative risk assessment is critical as we seek to ensure consumer safety whilst further understanding the positive peanut detections in garlic. In 2015 a recall was initiated after 610ppm of peanut was detected. Whilst it is unclear if the level reported is whole peanut or peanut protein, assuming worst case scenario of it being peanut protein to exceed ED01 just 0.33g would need to be consumed which is lower than a typical serving measure. By contrast in 2025 if we assume the highest alert detection reported is peanut protein at 0.62ppm then over 322g would need to be consumed.

These comparisons underscore the influence of both detection level and consumption assumptions and the importance of context-specific assessment.

Image 1. Comparison of 1g Garlic Powder vs 16g Garlic Powder[3]

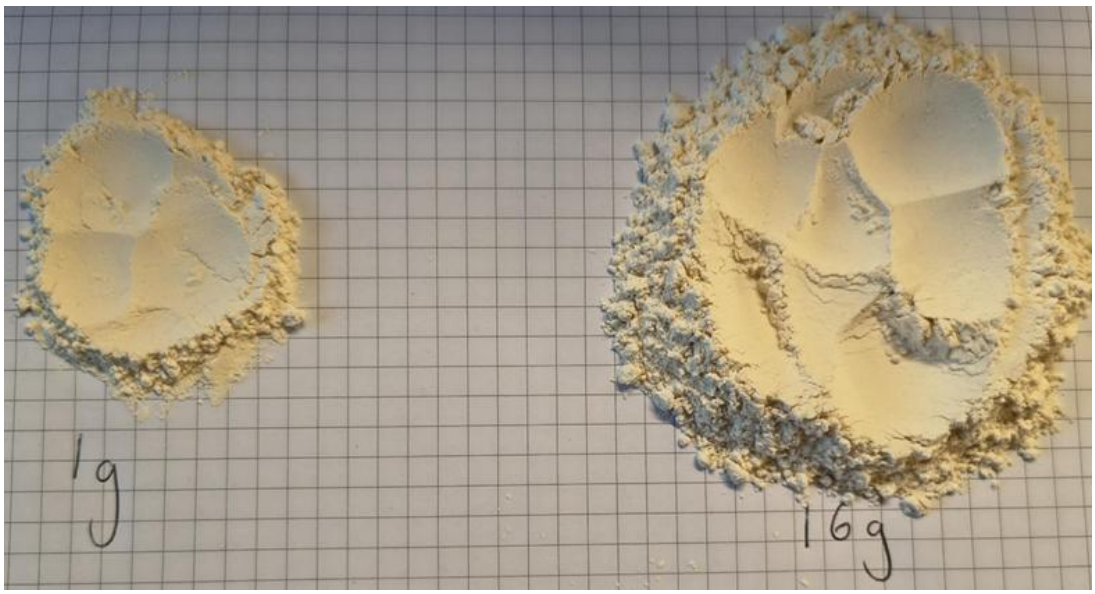
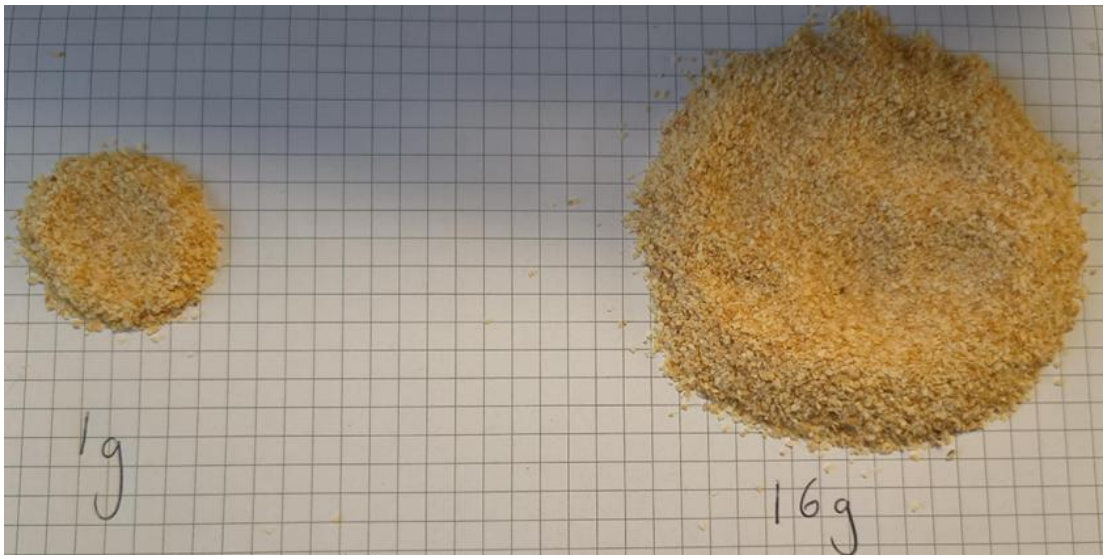


Image 2. Comparison of 1g Garlic Granules vs 16g Garlic Granules[3]



[3] 16g is over ten times lower than the amount that needs to be consumed to exceed ED01

A review of available garlic powders and granules from UK supermarkets revealed that the typical weight of a jar was around 42-55g, with some larger sizes available in some retail outlets.

The information on methods and functionalities provided by the laboratories varied, some confirming immediately the details of their test and if it was part of their scope of accreditation. Repeated attempts had to be made to retrieve the information from other laboratories.

Upon receipt of Certificates of Analysis from the laboratories, it was not immediately clear if the value being reported was, whole peanut or peanut protein. For those undertaking testing who are not familiar with the challenges that can occur with allergen testing for example matrix interference along with the different methods it can be very difficult to navigate the complexities, understand the results being reported and what they may indicate. To be clear, the number of importance is the peanut protein and not whole peanut.

Conclusion & Recommendations:

Analytical testing is an important tool in allergen management; however, results must be interpreted within a structured, risk based framework that considers supply chain controls, analytical variability, prevalence of detection, intended use and consumption patterns.

Analytical results and root causes can be ambiguous. To further identify and mitigate the root causes of peanut in garlic contamination, we recommend the formation of an Expert Working Group to be led by the SSA, comprising of various subject matter experts from wide ranging backgrounds including analytical methodology, plant physiology and academia. The aim of this group will be to further substantiate a harmonised risk assessed approach to interpreting positive detections in dehydrated Chinese garlic. Without this, the availability and supply of dehydrated garlic using a zero-tolerance approach will be severely impacted.

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